North
Atlantic

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The Northeast Utilities System

June 9, 1997

Docket No. 50-443
NYN-97062

United States Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, D.C. 20555

Seabrook Station
Licensee Event Report (LER) 97-008-00
Automatic Reactor Trip and Feedwater Isolation

Enclosed, please find Licensee Event Report (LER) No. 97-008-00 for Seabrook Station for an automatic reactor trip and feedwater isolation that occurred on May 10, 1997. This event is being reported pursuant to 10 CFR 50.73(a)(2)(iv).

Should you require further information regarding this matter, please contact Mr. Terry L. Harpster, Director of Licensing Services, at (603) 773-7765.

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Bruce Drawbridge for

Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer

cc: H. J. Miller, Regional Administrator
A. W. De Agazio, NRC Project Manager, Seabrook Station
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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-008-00:on 970510,automatic reactor trip & feedwater isolation occurred.Caused by inadequate monitoring & trending of intermediate range channels.Improved monitoring of IR NI channels.W/970609 ltr.

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1093

LICENSEE EVENT REPORT (LER)

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FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Seabrook Station	05000443	1 of 6

TITLE (4)

AUTOMATIC REACTOR TRIP AND FEEDWATER ISOLATION

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
05	10	97	97	008	00	06	09	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9): 1

POWER LEVEL (10): 08

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	X 50.73(a)(2)(iv)	OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Allen L. Legendre, Jr., Nuclear Licensing Supervisor	(603) 773-7773

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On May 10, 1997, at 0211 EDT during a routine shutdown to begin the fifth refueling outage, an automatic reactor trip and subsequent feedwater isolation occurred at approximately 8% Rated Thermal Power (RTP). The reactor trip was initiated by one of two Intermediate Range Neutron Flux Instrumentation (IR NI)[IG] channels. The high flux trip signal (set for 25% RTP) occurred when the IR NI high flux trips were automatically unblocked at 8% reactor power. The IR NI trip bistable for Channel N35 had not reset prior to unblocking the IR NI trips below the P-10 reset setpoint of 8% reactor power and thus initiated a trip signal when unblocked. Both IR NI channels, N35 and N36, had been affected by a significant shift in radial power distribution and channel N35 had experienced power supply degradation problems during the operating cycle. The cumulative effect of these two factors on the IR NI channels caused the trip signals to stay actuated below the power levels at which they should have normally reset. The four power range nuclear instruments indicated approximately 8% reactor power just prior to the trip. The IR NI reactor trip bistables should have reset at 12.5% RTP. This event was reported to the NRC at 0321 May 10, 1997, as a non-emergency event pursuant to 10CFR50.72(b)(2)(ii), automatic actuation of the Reactor Protection System [JC] and Engineered Safety Feature System [JE].

The causes of this event are: 1) the inadequate monitoring and trending of the intermediate range channels power supplies, 2) a collective lack of knowledge about the effects that changing IR NI detector currents have on IR NI reactor trip and reset setpoints, and 3) inadequate procedural guidance in the plant shutdown procedure regarding verification that the intermediate range neutron flux trips were reset prior to decreasing power below the P-10 setpoint.

Corrective actions include improved monitoring of IR NI channels, enhanced plant shutdown procedures and operator and technical training on this event.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Seabrook Station	05000443	97	-- 008 --	00	2 of 6

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. Description of Event

On May 10, 1997, at 0211 EDT during a routine shutdown to begin the fifth refueling outage, an automatic reactor trip and subsequent feedwater isolation occurred at approximately 8% Rated Thermal Power (RTP). The reactor trip was initiated by one of two Intermediate Range Neutron Flux Instrumentation (IR NI) channels. The high flux trip signal (set for 25% RTP) occurred when the IR NI high flux trips were automatically unblocked at 8% reactor power. The IR NI trip bistable for Channel N35 had not reset prior to unblocking the IR NI trips below the P-10 reset setpoint of 8% reactor power and thus initiated a trip signal when unblocked. Both IR NI channels, N35 and N36, had been affected by a significant shift in radial power distribution and channel N35 had experienced power supply degradation problems during the operating cycle. The cumulative effect of these two factors on the IR NI channels was to cause a slowly changing higher current input to the IR NI trip bistables even though real reactor power was not changing. The four power range nuclear instruments indicated approximately 8% reactor power just prior to the trip.

The IR High Flux reactor trip is not explicitly credited in any UFSAR Chapter 15 accident analysis. The IR NI trip provides back-up core protection during reactor startup to mitigate the consequences of an uncontrolled rod control cluster assembly bank withdrawal from a subcritical condition. This trip is manually blocked above 10% reactor power and is automatically unblocked when any three of the four power range channels drop below the permissive (P-10) setpoint reset value of 8% reactor power. The automatic unblocking ensures automatic transition to a more restrictive trip protection when decreasing reactor power levels. The intermediate range channels are normally set to initiate a reactor trip at an IR NI detector current level equivalent to approximately 25% RTP. Seabrook Station uses a standard Westinghouse recommended IR NI trip reset setpoint of 50 percent of the trip value, or 12.5% RTP.

The Intermediate Range Instrumentation is required in Mode 1 (below the P-10 setpoint) and Mode 2. The IR NI instruments are verified operable by performing the following Technical Specification Surveillance Requirements:

1) a CHANNEL CHECK at least once every 12 hours in Mode 1 (less than the P-10 setpoint) and Mode 2,
2) a CHANNEL CALIBRATION at least once every 18 months, and
3) an ANALOG CHANNEL OPERATIONAL TEST prior to each reactor startup.

At the beginning of each cycle, 100% RTP detector currents are obtained and the IR NI trip setpoints and resets are set based on these values. There are no additional requirements during the operating cycle to calibrate the IR NI instruments or to adjust their trip setpoints. The IR NI channels were last calibrated at the end of Cycle 4 on September 19, 1995. At the beginning of operating Cycle 5, on December 21, 1995, the IR NI channels were rescaled for 100% RTP. Following a plant trip in January of 1996, the IR NI channels were operationally tested and no adjustments to the trip or reset setpoints were necessary. The IR NI channels were scheduled for calibration within the required 18 month frequency in March of 1997. IR NI trip setpoints are derived from the detector current equivalent to 100% RTP. The detector current equivalent to 100% RTP is documented on Technical Data Book, figure RE-17 (NIS Channel and Loop Delta T Scaling).

Even though it was not procedurally required, reactor engineering personnel updated figure RE-17 to reflect revised IR NI detector currents during Cycle 5 in July 1996, September 1996 and March 1997. RE-17 was updated periodically so that if the reactor was shut down during the operating cycle, the most recent full power detector currents could be used to set the trip and reset values of the IR NI setpoints following the plant restart. The effect that long term significant change in detector currents was having on IR NI trip reset values while at 100% RTP was not recognized.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	
Seabrook Station	05000443	97	--	008	--	00	3 of 6

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

During Cycle 5, there were two factors that directly affected the IR NI reactor trip and reset setpoints. One factor was the cycle 5 radial power distribution shift. This shift was more aggressive than any in the previous operating cycles. Radial power distribution shifts throughout the operating cycle resulted in an increase in the IR NI detector currents because for the same 100% RTP, more power was produced in the outer edges of the core as the cycle progressed. Thus, the IR NI detectors saw more neutron flux leakage for the same steady state power level. The higher detector currents were monitored throughout the operating cycle and reflected in occasional updates of 100% RTP IR NI detector currents on figure RE-17 in the Primary Technical Data book. This increase in detector current output effectively lowered the IR NI reactor trip and reset setpoints in equivalent RTP.

During the operating cycle the radial power distribution change affecting the IR NI channels was evaluated by the Reactor Engineering (RE) department. The RE Department Supervisor recognized that this effect would lower the trip setpoint for the IR NI channels. This was seen to conservatively reduce the trip setpoints (i.e., an intermediate range high flux reactor trip would occur at a lower power level than anticipated) and no effort was made to compensate for the effect. However, he did not understand that the reduction in trip setpoints would also lower the reset values for the trip setpoints. He was not aware that the IR NI reactor trip reset setpoint was 12.5% RTP, half the trip setpoint of 25% RTP.

When it appeared the plant may have to shut down for maintenance repairs during the operating cycle, the RE supervisor discussed the increasing IR NI detector currents periodically with the Instrumentation&Controls (I&C) NI system supervisor. RE wanted to ensure that I&C had the most recent values of IR NI detector currents to use during IR NI channel calibration and/or rescaling or testing conducted during any subsequent plant restart. RE and I&C did not discuss the effect the increasing IR NI detector currents had on lowering the IR NI reactor trip setpoint. The system engineer was not notified of the increasing detector currents by RE or I&C.

Post trip evaluation revealed that the shifting radial power distribution and subsequent higher detector currents reduced the IR NI channel N35 trip setpoint to 16.9% RTP and the reset setpoint to 8.5% RTP. IR NI channel N36 setpoints were lowered to 17.9% RTP and 8.9% RTP for the trip and reset respectively.

A second factor affected the IR NI reactor trip and reset setpoints. The IR NI channel N35 trip and reset bistable circuit had a degraded +/- 25VDC power supply. Power supply degradation associated with IR NI channel N35 further lowered the IR NI trip and reset setpoints. No power supply degradation occurred on IR NI channel N36. The effects of similar power supply degradation on the power range and source range instrumentation were monitored, evaluated and compensated for throughout the operating cycle through Technical Specification required quarterly calibrations. No such monitoring or compensation was required nor occurred on the IR NI from February 1996 until the plant shutdown and reactor trip on May 10, 1997.

The power supplies for the power range nuclear instruments are similar to that of the intermediate range and source range. However, the effect on the IR NI was not monitored because the instruments were not required to be OPERABLE per Technical Specifications in Mode 1, greater than the P-10 setpoint. IR NI calibration is required every 18 months. The effect of the power supply degradation on IR NI was not considered due to the continuous plant operation at 100% RTP from February 1996 until the shutdown prior to the refueling outage on May 10, 1997. Monitoring of the power supply degradation was limited to the effect it had on the power range and source range channels. The power supply degradation was monitored throughout the operating cycle and the cause has not conclusively been determined. The power supplies are scheduled for refurbishment during the current refueling outage (OR05).

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	
Seabrook Station	05000443	97	--	008	--	00	4 of 6

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

The IR NI channel N35 degraded power supply effect further lowered the IR NI channel N35 trip setpoint to 14.5 percent power and the reset setpoint to 7% RTP. Thus the IR NI channel N35 trip *reset* setpoint was effectively reduced to 7% RTP, 1 percent below the P-10 reset setpoint of 8% RTP, due to the degraded condition of its power supply and the effects of the shifting radial power distribution. When the P-10 reset setpoint was reached at 8% RTP, the IR NI reactor trip block was automatically unblocked and the IR NI channel N35 reactor trip signal tripped the reactor. Channel N36 did not experience power supply degradation. Thus its setpoints were affected only by the radial power distribution change and the IR NI channel N36 trip signal reset just above the unblocking of the IR NI trips.

Immediately prior to the trip, operators had just completed a main turbine overspeed test and were focused on the power decrease and resultant steam generator level perturbations that occur at lower power levels. The Main Plant Evolution procedure OS1000.03 "Plant Shutdown from Minimum Load to Hot Standby" provided inadequate guidance regarding verifying the IR NI trip bistable lights were reset prior to decreasing power below the P-10 setpoint. As reactor power was decreased below 10% RTP, the channel N36 IR NI high flux trip bistable light reset at 9.5% reactor power, while the IR NI high flux trip bistable light for channel N35 remained actuated.

The timeframe between when N36 reset and the actual reactor trip was approximately 15 minutes. During this time the IR NI channel N35 bistable status lamp was illuminated indicating a channel trip on this particular channel. Interviews following the reactor trip revealed that during the shutdown the operating crews' focus was primarily on a controlled power reduction and manual transfer of the feedwater system to the startup feedwater pump. Steam generator level control at lower power levels has challenged operating crews in the past and thus the on-shift operating crew was determined to successfully transition through the difficult operating zone with no SG level perturbations. The bistable indication for N35 went unnoticed by the operating crew.

Following the reactor trip, a Feedwater Isolation Signal was actuated due to the combination of a reactor trip signal (P-4 permissive) and the expected reactor coolant system [AB] temperature decrease to its zero power value of 557 degrees Fahrenheit. The Feedwater Isolation Signal was subsequently reset and main feedwater [SJ] reestablished to the steam generators via the Startup Feedwater Pump. These actions prevented an automatic Emergency Feedwater [BA] Actuation on low-low steam generator levels.

At 0321 on May 10, 1997, North Atlantic made a non-emergency four-hour notification to the NRC pursuant to 10CFR50.72(b)(2)(ii), to report the automatic actuation of the Reactor Protection System and Engineered Safety Feature System.

II. Cause of Event

The inability of the organization to recognize and communicate that changing detector current levels and nuclear instrumentation power supply problems caused significant change to reactor trip and reset setpoints, resulted in a preventable event.

The three root causes of this event are:

1. Inadequate performance monitoring and trending of the intermediate range nuclear instrument channels.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	
Seabrook Station	05000443	97	--	008	--	00	5 of 6

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

The magnitude of the change in detector currents and potential impact on the trip and reset setpoints are factors that would normally be recognized by a solid performance monitoring program. The combined effects were not effectively monitored and evaluated for the broader implications regarding the intermediate range instrumentation .

2. Lack of knowledge of the effect of increasing detector current on instrument trip and reset values by several departments resulted in a lack of a questioning attitude.

The lack of knowledge specific to the nuclear instrumentation, by personnel in several departments, led to the failure to recognize the effect that increased detector currents and degraded power supplies had on IR NI reactor trip and reset setpoints. These failures are characterized as follows:

- Reactor Engineering and I&C department personnel did not recognize the need to inform the Technical Support system engineer about the increasing detector currents.

- Technical Support, Reactor Engineering and I&C did not fully appreciate the potential effect that the power supply degradation had on the IR NI channels and thus did not monitor the IR NI channels closely enough to detect and prevent the significant change in IR NI reactor trip and reset setpoints.

- Operators were not aware of the IR NI reactor trip reset setpoints and did not identify that the channel N35 IR NI trip bistable had not reset when it should have.

- Training did not fully understand the effect that increased IR NI detector currents had on the reactor trip and reset setpoints when they loaded the increased values into the simulator and ran a training scenario that resulted in a reactor trip on IR NI high flux sooner than expected during the scenario.

- No one in any of the departments involved, who were knowledgeable of the power distribution effect or the degraded power supply effect, understood the magnitude that these factors could have on lowering the IR NI reactor trip reset setpoint. Thus the combined effects on the IR NI trip and reset setpoints was not recognized prior to the reactor trip.

3. Lack of detail in the plant shutdown procedure created an over-reliance on the individual operators ability to observe, recognize and diagnose the imminent trip condition.

The guidance provided in OS1000.03, "Plant Shutdown from Minimum Load to Hot Standby," was not adequate regarding verification that the IR NI reactor trip should be reset prior to decreasing power below the P-10 setpoint. This inadequacy combined with insufficient training on "unblocked trips" during simulator plant shutdown scenarios contributed to the inability of the operators to recognize and prevent the reactor trip.

III. Analysis of Event

There were no adverse safety consequences as a result of this event. The response to the reactor trip and subsequent recovery actions by plant operators were determined to be correct. All plant system responses were normal and all control rods fully inserted into the core. The IR NI High Flux reactor trip is not explicitly credited in any UFSAR Chapter 15 accident analysis. The reduced setpoints associated with the IR NI did not affect the availability or performance of any other components or systems.

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IV. Corrective Action

1. Technical Support will adjust nuclear instrumentation monitoring frequency and develop a strategy for evaluating and compensating for the effect that core flux changes have on nuclear instruments.

2. Technical Support will increase the frequency for monitoring IR NI power supply degradation.

3. Operations has revised Main Plant Evolution Procedure OS1000.03, "Plant Shutdown From Minimum Load to Hot Standby" to require verification that the intermediate range high flux trip bistables are reset prior to decreasing reactor power below the P-10 setpoint.

4. The IR NI +/- 25 volt power supplies will be repaired during OR05.

5. Incorporate into Operator and Technical Training the lessons learned from this event.

V. Additional Information

None

Similar Events

None.

Manufacturer Data

None